



REPORT

ON

THE PRACTICABILITY AND PROBABLE EFFICACY OF
THE PROPOSED PLAN FOR

DEODORIZING THE SEWAGE

OF

LONDON,

BY MEANS OF

PERCHLORIDE OF IRON.

BY

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LONDON:

M. LOWNDS, PRINTER, 148 $\frac{1}{2}$, FENCHURCH STREET, CITY.

1860.

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At a Meeting of the Committee on Improvements of the Commissioners of Sewers of the City of London, at the Guildhall of the said City, on Thursday, April 26th, 1860 :—

The Medical Officer of Health laid before the Committee the following Report, prepared by order of the Court.

The same being read—Ordered :

That the Report be Printed, and a copy sent to every Member of the Court, and of the Metropolitan Board of Works.

JOSEPH DAW,

Principal Clerk.

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TO THE HONORABLE COMMISSIONERS OF
SEWERS OF THE CITY OF LONDON.

GENTLEMEN,

In accordance with your instructions I have considered the question submitted to me at the last meeting of the Board—viz., the probable efficacy of the proposed plan for deodorizing the sewage of London by means of Perchloride of Iron, and I have the honor to submit my Report thereon.

The question is manifestly of the greatest importance, and it must be acknowledged that it is

surrounded with difficulties : nevertheless it must be dealt with ; for the state of the river during the last two summers, and the certainty of its becoming as bad as ever during the hot months of the present year, are matters for serious consideration. It is true that little or no mischief, as far as we can discover, has yet been done to the public health ; but in the face of all experience, it would be rash indeed to conclude that our present immunity from disease is sufficient proof of a total absence of danger, and of the non-necessity for interference. Who, indeed, can say what little or last condition may be necessary, or what accident may happen to call into activity the zymotic powers of disease which may now only be waiting for their final development ? For my own part, I have looked with anxiety upon the subject, and have watched with care the state of the river during the last two years, and the concomitant condition of the public health ; for I could not shut my eyes to the fact, that all knowledge derived from antecedents has proved beyond doubt that cholera and its congeners have shown a special affinity for those places where putrid miasms are abundant. There the visitations of epidemic disease are most frequent, and there they acquire the strength which enables them to migrate into surrounding districts. As your medical adviser, therefore, on matters connected with the public health of this city, I have considered it

to be my duty to direct your attention, again and again, to the state of the river ; and to this end I have kept myself constantly informed of its chemical condition, and have sought, by the aid of experiment and observation, to discover the true cause of the mischief, and find a remedy for it.

Not only have I tested in the laboratory the powers of almost every disinfectant that has been proposed, but I have also visited the principal Towns in England where processes of deodorization are largely carried out, and I am bound to state that the result of all these inquiries, guided by the principles of chemistry and hygiene, is not favorable to the proposed scheme of the Metropolitan Board.

The plan which is recommended is to cast into the sewers during the hot weather a concentrated solution of Perchloride of Iron. This is to be used in the proportion of about six grains to the gallon of sewage ; and the precipitate which it forms with the sewage is not to be removed, but is to be allowed to flow into the Thames with the rest of the liquor. The result of this will be, not a *prevention* of the putrefactive process, but merely a *delaying* of it. At the utmost its effects will last for only about nine days, and then the putrefactive change will continue in its usual way.

This is not only the result of my own experience of the process, but it is also admitted to be the experience of Drs. Hofmann and Frankland, who have advised the Board on the subject; for they say “that the suspended matter, even when separated from the deodorized sewage, rapidly passes, in warm weather, into a state of active putrefaction.” The same opinion has been again and again expressed by Dr. Hofmann in respect of the solid matter which is cast down from sewage by the addition of lime. He has even gone so far as to say, that on sanitary grounds no process of disinfection is perfect that does not *destroy* the organic matter of sewage, as is the case with chloride of lime, and the permanganates of potash and soda.

When chloride of iron is added to sewage, the utmost effect of it will be but to fix a small portion—about one-third—of the ammonia contained in sewage, and to precipitate the sulphuretted hydrogen as a black and filthy-looking compound. This precipitate will be rapidly cast down, and will carry with it the suspended matters of sewage, leaving a clear liquor in which the organic miasms are untouched: and here it is that chemistry, when unassisted by pathology, physiology, and hygiene, is liable to the most serious errors, and may give rise to a dangerous confidence in her abstract speculations. Doubtless the removal of a filthy

odour like that of sulphuretted hydrogen may in some degree be an advantage; but there is not the remotest proof that these are the only or even the principal agents which excite disease, and there is no scientific reason whatever for believing that their removal is sufficient to interfere with the origin or spread of epidemic disease.

But worse yet:—Not only is the clear liquor still charged with ammonia and organic miasms, and so far is not disinfected, but the bulky precipitate, which contains all the suspended organic matter, will soon subside, because of its high specific gravity, and will settle upon the banks of the river, where it will be left by the receding tide, and where its disgusting appearance will assuredly excite alarm; besides which the putrefactive changes through which it will pass, will render it no less offensive than the present mud, which Dr. Hofmann has characterised as “by far the most serious evil which results from the discharge of the London sewage into the river.”

If the process recommended to the Board, had for its object the *separation* of suspended matters from the sewage, and the disposal of the clear defœcated liquor, it might perhaps have been applied with some prospect of success; for this in truth, is the basis of the plans adopted by the

Metropolitan Board, and now in process of execution. Those plans are the result of careful inquiry and deliberation; for when with Messrs. Bidder, Hawksley, and Bazalgette, I examined the processes which are already in practice at Leicester and elsewhere for the defœcation of sewage, I was fully convinced that no process of disinfection would be successful, that did not provide for the *final and complete removal* of the suspended matters of sewage. The mere addition of a precipitant, without the separation of the feculent matter so precipitated, was abundantly proved by experiment and observation to be a wasteful and worthless proceeding.

Even in the case of the iron solution, which is proposed to the Board, it has in every instance most signally failed as a practical deodorizer. More than two years ago I made a large number of experiments on the deodorizing power of Perchloride of Iron, and the results were communicated to you in my report on Sewage and Sewer Gases. I found that it was the least effective, and at that time the most expensive of all the deodorizers known. I calculated that if it were used in proper proportion, to check finally and completely the putrefaction of sewage, it would cost nearly forty-eight millions a year to deodorize the sewage of London. Since that time, the price of the solution has fallen to a twelfth part of what it then

was ; but its cost as an effective deodorizer is still enormous. It is not ten or twenty or forty grains of the solution, that will have a proper hygienic effect upon the river ; but it must be used in the proportion of hundreds of grains to the gallon, to put a final check upon the putrefactive process. This I have demonstrated by actual experiment, and therefore, speak of it with confidence.

Nor do the results of my experiments stand alone, as proof of this conclusion ; for your own Engineer, Mr. Haywood, inquired into this matter, at your request, as far back as the month of March in 1848 ; and he reported to you that when Ellerman's solution was used in the proportion of three gallons to a cubic yard of night soil, it was not so perfect in its deodorizing power as five pints of a solution of Chloride of Zinc. The solution of perchloride used by Mr. Haywood was supplied to him by Mr. Ellerman himself.

Later still the subject was inquired into by Mr. Hodgson, and reported on to the Metropolitan Sewers' Commission. His report bears the date of April 1848 ; and, like Mr. Haywood, he found that Ellerman's solution was but an imperfect deodorizer : in point of fact, he only sought to remove ammonia and sulphuretted hydrogen, and

these required as much as eleven and a half quarts, or nearly three gallons of Mr. Ellerman's liquid for a cubic yard of night soil, whereas the fluid of Sir Wm. Burnett (chloride of zinc) required but one quart. These and other experiments were so unsatisfactory that the liquid was not used either by the City or the Metropolitan Commissioners.

Again:—about four years ago, Mr. Davy, the Professor of Agricultural Chemistry to the Royal Dublin Society, undertook a series of experiments for the purpose of ascertaining what substances might be successfully used as deodorizers of night soil. The salts of iron were used among others, and he says of sulphate of iron, which is the homologue of the perchloride, that its efficacy was but little superior to that of sand.

And lastly,—we have the experimental and practical failure of Mr. Ellerman's plan, under his own immediate supervision, as the best of all reasons for concluding that the process is not effective. Some years ago his deodorizing establishment was at Whitechapel; and although it was in a colony of nuisances, and sanitary measures were not then prosecuted with the rigour which they now are, yet his works were so intolerably offensive, that the parish authorities were obliged to take proceedings against

him, and his factory was closed. I inspected it at that time for the Parish, for there was then no local Board of Health, and my conclusions were that his process was a signal failure, and was wholly inoperative as a sanitary scheme. I will not venture to pursue its history further, except to say, that for more than a dozen years it has been a profitless and useless speculation. Nay more:—the salts of iron, in one form or another, have been before the public as possible deodorizers for nearly a hundred years, and yet, as far as I know, with singular want of success. In 1762, the salts of lead and iron were recommended as antiseptics by De Boissieu, and from that time to this they have been the subjects of numerous patents; the last of them all was the patent of Brown, and its modification by Ellerman, in 1847; but where, I would ask, with all this historical prestige, is there the slightest proof of its practical utility, or even of its theoretical capabilities? This is by no means an unimportant question, when we consider that the adoption of this scheme is not only for the sake of the public health, but also at the cost of a large sum of public money.

I refrain from entering more deeply into the subject; for the reference to me merely requires that I should express my opinion of the proposed scheme. It is, therefore, sufficient for me to say

that, as far as my knowledge and experience and experiments have gone, I am led to the conclusion that the use of Perchloride of Iron as a disinfectant of sewage, and a purifier of the Thames, will be a serious failure, unless indeed means are taken for the separation of the solid matter from the sewage, and the disposal of the clear liquid alone.

You will perceive by the Tables in the Appendix what kind of matter there is in the sewage, and how much of it is to be dealt with ; and I may here remark that under ordinary circumstances, when the down-flow of fresh water in the river is sufficient to dilute the sewage, and to keep back the oceanic wave from the sea, little or no inconvenience is occasioned by it ; for so rapid is the oxydising power of atmospheric air and water, that the decomposing products are quickly hurried through their phases of putrefaction : but in summer time, when evaporation is great and there is a scarcity of fresh water, when the sewage becomes more abundant, and the sea water advances to meet it, then it is that putrefactive decomposition sets in and the river becomes offensive. At the present time the total quantity of solid matter in the Thames at London Bridge is not more than twenty-five grains in the gallon, and of this only about three grains are organic. These are the proportions of its constituents throughout

the whole of the winter season, and up to nearly the end of May ; but at that time the falling off in the supply of fresh water begins to be felt, and soon the proportion of saline matter amounts to upwards of a hundred grains in the gallon, and the quantity of organic to about ten. At this stage of saturation, with a high temperature, putridity begins ; and as the summer advances, and the proportions increase to upwards of 300 of salt and nearly 20 of organic matter, the decomposition is most active. To guard, therefore, against these changes, it is not enough to check the putrefaction of the sewage with a few grains of Perchloride of Iron, but provision must be made for the hindrance of that decomposition which will assuredly occur with the organic matter that is already pickled as it were in the sea water, and which soon becomes tainted by the decomposing sewage. This it was which added to the putridity of the river during the last summer, and which maintained it in its offensive condition, notwithstanding the use of nearly 500 tons of chloride of lime, and upwards of 4,000 tons of the caustic alkali. The mistake then was, as I fear it hereafter will be, that the suspended matters of the sewage were not retained, but that the precipitate formed with the disinfectant was allowed to flow on into the river, and so to become a dangerous nuisance ; and let me add, that whatever opinion

may be formed of the necessity for adopting some temporary expedient as a palliative of the stinking condition of the river, it is surely not necessary to resort to chemical artifice for that which is no other than an elaborate disguise of an unremoved nuisance.

I have the honor,

GENTLEMEN,

To remain, your obedient Servant,

HY. LETHEBY.

GUILDHALL,

April 26th, 1860.

No. I.—Table of the Proportions of Solid Matter (Mineral and Organic) in a Gallon of the Sewage discharged by each of the City Sewers, at Noon.

NAMES OF SEWERS.	Average rate of flow per minute, in cubic feet. (Haywood.)	Date when taken (1857.) Noon.	Mean external temperature of the day. ° Faht.	Rainfall of the day preceding Inches.	SOLUBLE CONSTITUENTS.			SUSPENDED CONSTITUENTS.			GRAND TOTAL. Grains.
					Mineral. Grains.	Organic. Grains.	Total. Grains.	Mineral. Grains.	Organic. Grains.	Total. Grains.	
The Fleet	1642·39	May 29	55·6	0·00	33·00	11·60	44·60	12·60	16·40	29·00	73·60
London Bridge	1396·71	" "	"	"	37·09	20·96	58·05	15·40	7·04	22·44	80·49
Dowgate Dock	58·85	July 17	63·0	0·00	38·36	27·31	65·67	13·26	16·64	29·90	95·57
Irongate	170·18	May 23	56·7	0·28	65·01	11·20	76·21	16·32	15·80	32·12	108·33
Paul's Wharf	117·15	" "	"	"	51·35	21·79	73·14	32·21	17·21	49·42	122·56
Whitefriars Dock	63·36	" 29	55·6	0·00	23·02	3·53	26·55	4·89	9·59	14·48	41·03
Custom House, West ..	22·16	July 17	63·0	0·00	64·30	9·22	73·52	42·21	36·28	78·49	152·01
Custom House, East....	7·13	" 24	70·8	0·00	37·82	20·19	58·01	14·82	12·31	27·13	85·14
Hambro' Wharf	7·64	May 23	56·7	0·28	32·79	14·24	47·03	12·75	4·26	17·01	64·04
Wool Quay	4·02	July 20	69·3	0·00	23·84	10·76	34·60	46·41	35·04	81·45	116·05
Tower Dock	4·69	" 24	70·8	0·00	846·30	43·96	890·26	14·60	16·14	30·74	921·00
Average, exclusive of } Tower Dock	348·96	..	..	..	40·66	15·08	55·74	21·09	17·06	38·15	93·89

N.B.—The Tower Dock is excluded because of the peculiar composition of the Sewage—dependent on the trade operations among the fishmongers and shell-fish boilers of the neighbourhood.

No. II.—Quantities required of each of the Principal Deodorizers to remove the odour, more or less completely, from ordinary London Sewage; and the Annual Cost of each of the Materials for Deodorizing the Sewage of the City, and of the Metropolis.

NAMES OF THE DEODORIZERS.	Price of the Deodorizers.	Strength of the Solution (specific gravity.)	Quantity required per gallon of Sewage. (grains.)	Results as to the Deodorization.	ANNUAL COST OF MATERIALS FOR DEODORIZING.	
					The City Sewage (20,316,442 gals.) per day.	The Sewage of Metropolis (84,759,150 gals.) per day.
Quick Lime	10s. per ton	....	12	Incomplete	£2,837	£11,838
Chloride of Lime	£15 "	....	8	Complete	56,751	236,955
McDougall's Powder	£12 "	....	40	Incomplete	227,004	947,053
Peat Charcoal	£3. 5s. "	....	150	Ditto	230,573	961,851
Condy's Liquid	1s. per gall.	1,055	150	Complete	753,165	3,141,884
Sir Wm. Burnett's Liquid	4s. "	1,594	100	Incomplete	1,329,181	5,545,275
Ledoyen's do.	4d. "	1,160	1000	Ditto	1,522,065	6,349,975
Ellerman's do.	9d. "	1,443	470	Ditto	1,293,913	5,999,184

NOTE.—Condy's Liquid of specific gravity 1055, contains 5·9 per cent. of permanganate of potash.
 Sir Wm. Burnett's Liquid 1594, " 53·8 " chloride of zinc.
 Ledoyen's ditto 1160, " 10·0 " nitrate of lead.
 Ellerman's ditto 1443, " 43·0 " muriate and pyrolignite of iron.

The thick matter of cesspools and stagnant sewers requires about a 20th part of its weight of chloride of lime to deodorize it, and the corresponding proportions of the other deodorizers.

In those cases where the deodorization is incomplete, the peculiar smell of sewage remained,—sulphuretted hydrogen, and, except in the case of quick lime, ammonia being the only matters removed.

No. III.—Table of the Mean Composition of Thames Water at High Tides at London Bridge, during the Spring, Summer, and Winter Months of 1858, 1859 and 1860.

PROPERTIES AND CONSTITUENTS. (Per Imperial Gallon.)		MID-STREAM.							
		DEC. to MAY, 1860.	MAY, 1859.	JUNE.		JULY.		AUGUST, 1859.	SEPT., 1859.
				1858.	1859.	1858.	1859.		
Appearance after standing	.....	Clear.	Turbid.	Turbid.	Turbid.	Turbid.	Turbid.	Turbid.	Turbid.
Odour	.....	None.	Very Bad.	Very Bad.	Very Bad.	Very Bad.	Bad.	Bad.	Bad.
Colour of the Deposit	.....	Brown.	Black.	Black.	Blackish.	Black.	Black.	Black.	Blackish.
DISSOLVED CONSTITUENTS	.....	25.51	94.02	74.59	157.82	192.55	302.86	410.12	410.12
Organic	.....	2.65	6.94	7.17	15.78	16.13	20.00	23.33	23.33
Mineral	.....	22.86	87.03	67.42	142.04	176.42	282.86	386.79	386.79
SUSPENDED CONSTITUENTS	.....	9.21	9.51	13.73	16.67	8.76	7.99	6.47	6.47
Organic	.....	1.12	1.68	1.58	3.30	2.12	2.33	1.56	1.56
Mineral	.....	8.09	7.83	12.15	13.37	6.64	5.66	4.91	4.91
Total (Grains per Gallon)	.....	34.72	103.53	88.32	174.49	201.31	310.85	416.59	416.59
Ammonia Evolved by Heating (Grains)	.....	1.11	1.24	1.03	0.72	1.25	1.26	1.26	1.26
Combined Sulphuric Acid	.....	2.67	7.05	5.68	9.78	14.11	20.62	27.26	27.26
Alkaline Chlorides	.....	3.76	65.59	52.56	121.30	174.61	225.44	328.85	328.85
Mean Temperature of River (Degrees)	.....	41.08	54.70	65.60	65.30	71.30	68.40	63.00	63.00
Total Rain-fall in Month (Inches)	.....	2.45	2.03	1.94	2.35	2.38	0.88	2.15	2.15

No. IV.—*Table of the Mean Composition of Thames Water at High Tides at London Bridge, during the Spring, Summer, and Winter Months of 1858, 1859, and 1860.*

PROPERTIES AND CONSTITUENTS. (Per Imperial Gallon.)		SIX FEET FROM SHORE ON CITY SIDE.						
	DEC. to MAY, 1860.	MAY, 1859.	JUNE.		JULY.		AUGUST, 1859.	SEPT., 1859.
			1858.	1859.	1858.	1859.		
Appearance after Standing	Clear.	Turbid.	Turbid.	Turbid.	Turbid.	Turbid.	Turbid.	Turbid.
Odour	None.	Bad.	Very Bad	Very Bad.	Bad.	Very Bad.	Bad.	Bad.
Colour of the Deposit	Brown.	Blackish.	Black.	Black.	Blackish.	Black.	Black.	Blackish.
DISSOLVED CONSTITUENTS	25·00	81·55	102·50	70·33	108·56	153·25	234·01	352·82
Organic	2·56	6·22	9·33	6·67	11·68	12·80	18·80	23·22
Mineral	22·44	75·33	93·17	63·66	96·88	140·45	215·21	329·60
SUSPENDED CONSTITUENTS	5·50	21·38	12·42	18·84	34·62	13·67	14·23	26·67
Organic	1·12	3·37	4·41	3·17	6·34	3·45	3·04	4·78
Mineral	4·38	18·01	8·01	15·67	28·28	10·22	11·19	21·89
Total (Grains per Gallon)	30·50	102·93	114·92	89·17	143·18	166·92	248·24	379·49
Ammonia on Heating (Grains)	1·20	1·70	2·52	1·19	1·79	1·91	1·93	1·10
Combined Sulphuric Acid	2·94	5·73	4·46	5·15	8·58	11·74	16·81	24·30
Alkaline Chlorides	3·05	62·25	66·75	46·91	70·14	118·92	180·18	290·59
Mean Temperature of River (Degrees)	41·08	54·70	66·80	65·60	65·30	71·30	68·40	63·00
Total Rain-fall in Month (Inches)	2·45	2·03	1·18	1·94	2·35	2·38	0·88	2·15